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The 3 omegas - not as easy as 1, 2, 3

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Abstract
A fatty acid database developed by Mann & others (2003) was used to determine the Australian intakes and food sources of long chain n-3 polyunsaturated fatty acids from the 1995 National Nutrition Survey (NNS). Average daily intakes of eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) were 0.056, 0.026, and 0.106 g/d respectively (Meyer & others 2003). Subsequent inclusion of newly available data on meats into the fatty acid database and re-analysis of the NNS resulted in higher calculated intake of DPA (0.071 g/d) because DPA content of meats was previously underestimated (Howe & others 2006). However, fish/seafood is still the main contributor to LC n-3 PUFA intakes. The food industry also now provides foods fortified with LC n-3 PUFA. Hence the fatty acid database warrants continual updating.

Keywords
omegas, not, easy

Disciplines
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A fatty acid database developed by Mann & others (2003) was used to determine the Australian intakes and food sources of long chain n-3 polyunsaturated fatty acids from the 1995 National Nutrition Survey (NNS). Average daily intakes of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid (DPA) were 0.026g, 0.106g and 0.018g respectively (Meyer & others 2003). Subsequent inclusion of newly available data on meats into the fatty acid database and re-analysis of the NNS resulted in higher calculated intakes of EPA (0.071g/d) because EPA content of meats was previously underestimated (Howe & others 2006). However, fish/seafood is still the main contributor to LC n-3 PUFA intakes. The food industry also now provides foods fortified with LC n-3 PUFA. Hence the fatty acid database warrants continual updating.

Health authorities advocate a healthy diet which includes a reduction in saturated fat and increased consumption of unsaturated fats, especially omega-3 polyunsaturated fatty acids (n-3 PUFA). The n-3 PUFA consist predominantly of alpha-linolenic acid (LNA), eicosapentaenoic acid (EPA), docosahexaenoic acid (DPA) and docosapentaenoic acid (DHA) and most health benefits have been attributed to the latter three, namely the long chain n-3 PUFA (LC n-3 PUFA). Humans are able to synthesise the LC n-3 PUFA from LNA, although the physiological relevance of such a small proportion of conversion (estimated at 0.03-0.04%) is questionable (Budge 2004). Hence direct consumption of the LC n-3 PUFA may be more beneficial than relying on LNA intakes and their subsequent conversion to the LC n-3 PUFA. However, in order to be able to determine the PUFA intakes of a population, for example, a nutrient database containing accurate data on nutrients, especially ALA and EPA; is needed.

In the early 1990s, teaching and research in the area of n-3 PUFA were then, and still are, exciting. However, the lack of detailed nutrient databases on the n-3 PUFA content of foods was a great need to update and establish a fatty acid database which contained the detailed information on all fatty acids, including the LC n-3 PUFA.

Methods

In 1995, all existing published data on n-3 PUFA content of foods were collated and published in food Australia in 1999 (Meyer & others 1999). The collated data were used to determine the intakes and food sources of n-3 and n-6 PUFA. However, data were often obtained as % of total fatty acids and if the total lipid content was reported and a relevant lipid conversion factor was used (Caulfield & others 1997) this allowed us to calculate the fatty acid concentrations as mg/100g. In total, 1044 foods were included in the RMIT fatty acid database (Mann & others 2003). The RMIT fatty acid database included all existing databases of fatty acids from the literature or new databases published in Meyer & others (2003).

However, since then, an additional 350 newly analysed long chain PUFA contents of red meat have been incorporated into the fatty acid database as described by Howe & others (2006). The Australian intakes and food sources of LC n-3 PUFA from the 1995 National Nutrition Survey (Mclennan & others 1997) were re-determined and published in Meyer & others (2003).
Results

Table 1 shows the collated published PUFAs results for a few examples of fish. There is great variation in these results. For example, the edible portions of fish can range from 500 to 2100 mg/100 g edible portion which is a 3.5-fold difference. Barramundi EPA, DPA and DHA content also vary greatly with a 6-fold difference in EPA, DPA and DHA levels (Table 1). These are also differences in the processed fish products with an approximate 2-fold difference in total fat and EPA, DPA and DHA levels when comparing different brands.

The results of the development of a fatty acid database containing approximately 1100 foods have been published previously (Mann & others 2005). Only analytical data, and not estimated or derived data are expressed in g/100 g of food or food product. The estimated or derived data are expressed in g/100 g of food or food product and are typically those results in which the estimated or derived contents are based on common practice and quality of data available in the literature.

The fatty acid database is used in the dietary analysis software platform, Foodworks (Xyris 2002).

Table 2 shows the estimated Australian intakes of LC n-3 PUFAs over time as described in the methods section. The two examples, namely the Ilawarra region of NSW intakes (Ollis & others 2005) and the 1995 National Nutrition Survey intakes (Mann & others 2003) are comparable. The third estimate of LC n-3 PUFAs (Howe & others 2006) is higher than the original two estimates and this is reflected primarily in higher DHA intakes.

Discussion

A fatty acid database which includes the LC n-3 PUFAs has been established, despite various limitations including the great variation in LC n-3 PUFAs content, especially in fish products (Table 1). This great variation in LC n-3 PUFAs data could be due to a number of factors, e.g. differences in environments, different food sources and different phases of feeding when the fish were caught. Furthermore, whether the fish samples included the skin and the fat depots under the skin makes a huge difference in the total fat content as well as the different types of fat. The processing of fish for canning could also influence the total and LC n-3 PUFAs content of fish products (Meyer & others 1999). NUTTAB95 (ANZFA 1999) and Nichols (1998) provided the information regarding the most commonly consumed fish and seafood in Australia for inclusion in the fatty acid database (Mann & others 2003).

The fatty acid database within the dietary analysis software platform Foodworks (Xyris 2002), as a stand alone database for analyses of fatty acid composition of foods, has the limitation that to analyse dietary intake data double entry is necessary in order to obtain the full complement of nutrient analyses, including energy, macronutrient and micronutrient analysis as well as the detailed fatty acid analysis. To rectify this, the ultimate goal is to incorporate the database into the main Australian nutrient database. The difficulty with incorporating the fatty acid database is that there is no compositional information about these foods other than fatty acids. Therefore, information regarding total weight, moisture content, total energy or any of the other macronutrients and micronutrients. Hence the double entry of fatty acids into the database and then again into the fatty acid database is the only option available at the moment.

The most important use of nutrition databases is for the purpose of nutrient analysis of food intakes. However, if erroneous data or "old data" were used in the database, then the nutrient estimates can be misleading. For example, the 1995 National Nutrition Survey had to be analysed twice for estimating fatty acid intakes: once using the fatty acid database (Mann & others 2003) and the second time, using the updated data on meat (Meyer & others 2003, Howe & others 2006), respectively seen in Table 1. Using "old data" can deliver different results. There was a 2.76-fold difference in the estimated DPA intakes of adult Australians and primarily due to underestimates of DPA in meats. It was originally thought that meat contributed approximately 20% of intakes of LC n-3 PUFAs (Meyer & others 2003) whereas realizarusing the updated database on meats, it was shown that this contribution is as high as 43% of LC n-3 PUFAs intake. This is not to say that meat is a high source of LC n-3 PUFAs, but more than six times more (at 164 g/day) than fish on average (28 g/day) (Ollis & others 1999). Therefore meat makes a high contribution to our total LC n-3 PUFAs intake, even though fish/seafood is the richest food source of LC n-3 PUFAs. This highlights the need to continually update the database as new analytical data becomes available. Furthermore, there has been a marked swing from consuming wild caught fish to farmed fish which tend to have different fatty acid profiles, therefore these databases do not only need to incorporate data improvements but also should reflect dominant eating habits in the population under study.

Most Australians do not consume fish/seafood regularly if at all, but the fish industry has been proactive in developing foods fortified with LC n-3 PUFAs, including fortified breads, muffins, margarines, milks and eggs, and so on. With the introduction of these fortified foods, the fatty acid databases will need to be continually updated. Another way and perhaps easier way to increase the consumption of LC n-3 PUFAs is dietary supplements. There are several brands available in the marketplace, including double strength capsules as well as fruit flavoured ones for children.

In summary, firstly there has been progress on the development of a fatty acid database for Australian foods; however, it has its limitations in the requirement for continuous updating of food, as a stand alone database there is a requirement for double entry of dietary intake data. Secondly, uses of nutrient databases need to understand the sources and quality of published data, whether they are analytical data or calculated/derived data, otherwise results of dietary intake analyses can be misleading.

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References


Table 1. Examples of differences in published lipid data on fish.

<table>
<thead>
<tr>
<th>Fish</th>
<th>Fat (mg/100g)</th>
<th>Fatty acids</th>
<th>Total n-6 (mg/100g)</th>
<th>18:3n-3 (mg/100g)</th>
<th>20:3n-6, 22:3n-6, 22:6n-3 (mg/100g)</th>
<th>Total n-3 PUFAs (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barramundi</td>
<td>880</td>
<td>131</td>
<td>14</td>
<td>84</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>Barramundi</td>
<td>600</td>
<td>99</td>
<td>4</td>
<td>122</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>Barramundi</td>
<td>2100</td>
<td>82</td>
<td>35</td>
<td>52</td>
<td>506</td>
<td></td>
</tr>
<tr>
<td>Salmon</td>
<td>7100</td>
<td>582</td>
<td>108</td>
<td>1856</td>
<td>2131</td>
<td></td>
</tr>
<tr>
<td>Salmon</td>
<td>1500</td>
<td>48</td>
<td>5</td>
<td>615</td>
<td>656</td>
<td></td>
</tr>
<tr>
<td>Salmon</td>
<td>1800</td>
<td>179</td>
<td>13</td>
<td>571</td>
<td>134</td>
<td></td>
</tr>
<tr>
<td>Canned Salmon-red</td>
<td>6400</td>
<td>95</td>
<td>35</td>
<td>858</td>
<td>960</td>
<td></td>
</tr>
<tr>
<td>Canned Salmon-red</td>
<td>12300</td>
<td>191</td>
<td>104</td>
<td>1963</td>
<td>2231</td>
<td></td>
</tr>
<tr>
<td>Canned Salmon-red</td>
<td>10400</td>
<td>178</td>
<td>89</td>
<td>1746</td>
<td>2133</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Comparison of LC n-3 PUFAs (mg/d) intakes over time using various databases.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Database used</th>
<th>EPA</th>
<th>DPA</th>
<th>DHA</th>
<th>Total LC n-3 PUFAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann &amp; others (2003)</td>
<td>Labour Force</td>
<td>567</td>
<td>26</td>
<td>100</td>
<td>188</td>
</tr>
<tr>
<td>Meyer &amp; others (2003)</td>
<td>Fish fatty acid database</td>
<td>58</td>
<td>26</td>
<td>100</td>
<td>188</td>
</tr>
<tr>
<td>How &amp; others (2006)</td>
<td>Updated fatty acid database</td>
<td>70</td>
<td>71</td>
<td>100</td>
<td>246</td>
</tr>
</tbody>
</table>

Acknowledgements

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